

# Sleep architecture and obstructive sleep apnea in obese children with and without metabolic syndrome: a case control study

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## Abstract

**Purpose** Obesity and biochemical parameters of metabolic disorders are both closely related to obstructive sleep apnea (OSA). The aim of this study was to compare sleep architecture and OSA in obese children with and without metabolic syndrome.

**Methods** Forty-two children with metabolic syndrome were selected as case group and 38 children without metabolic syndrome were matched for age, sex, and BMI as control group. The standardized Persian version of bedtime problems, excessive daytime sleepiness, awakenings during the night, regularity and duration of sleep, snoring (BEARS) and Children's Sleep Habits Questionnaires were completed, and polysomnography (PSG) was performed for all study subjects. Scoring was performed using the manual of American Academy of Sleep Medicine for children. Data were analyzed using chi-square test, *T* test, Mann–Whitney *U* test, and logistic regression analysis.

**Results** Non-rapid eye movement (NREM) sleep and N1 stage in the case group were significantly longer than the control group, while REM sleep was significantly shorter. Waking after sleep onset (WASO) was significantly different between two groups. Severe OSA was more frequent in the control group. Multivariate logistic regression analysis

showed that severe OSA (OR 21.478, 95 % CI 2.160–213.600; *P* = 0.009) and REM sleep (OR 0.856, 95 % CI 0.737–0.994; *P* = 0.041) had independent association with metabolic syndrome.

**Conclusions** Obese children with metabolic syndrome had increased WASO, N1 sleep stage, and severe OSA. But the results regarding sleep architecture are most likely a direct result of OSA severity. More longitudinal studies are needed to confirm the association of metabolic syndrome and OSA.

**Keywords** Metabolic syndrome X • Obesity • Obstructive sleep apnea • Sleep stages • Polysomnography

## Introduction

Overweight and obesity are of the serious health problems of the twenty-first century. Prevalence of metabolic syndrome in overweight and obese children is higher than normal weight population [1]. Despite a lower prevalence of obesity in Asia compared with Europe, metabolic syndrome is progressed as a health problem in these countries [2]. Prevalence rates of metabolic syndrome in Turkey and Iran are unusually high, similar to the USA [2].

The risk of obstructive sleep apnea (OSA) is higher in obese children and adolescents. OSA occurs frequently and more severe in obese children compared with lean children [3]. In the study by Chay et al., 12.5 % of reportedly asymptomatic children were found to have OSA [4]. OSA is associated with active inflammatory mechanisms that are activated in obesity [5]. Obesity and OSA are associated with adverse cardiovascular, metabolic, and neuropsychological consequences [6]. Obesity is an important factor in the assessment of adverse metabolic outcomes in OSA [7].

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metabolic syndrome among children and adolescents, using other criteria for diagnosis of the metabolic syndrome may result in different findings.

In conclusion, obese children with metabolic syndrome had increased WASO and N1 stage and severe OSA. But the results regarding sleep architecture are most likely a direct result of OSA severity in obese children with metabolic syndrome. Screening obese children with metabolic syndrome for OSA should be considered as well as attention to snoring and restless during sleep as important symptoms. Both OSA and metabolic syndrome and the related outcomes, regardless of their association, are modifiable by lifestyle changes and other specific interventional therapies. More longitudinal studies are necessary to confirm the association of metabolic syndrome and OSA.

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**Compliance with ethical standards** The research involved human participants. The study protocol was approved by the ethics committee of the Qazvin University of Medical Sciences. All procedures were in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Written informed consent was taken from both parents and participants.

**Conflict of interest** The authors declare that they have no competing interests.

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